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September 27, 2000

UTILITY PATENT APPLICATION TRANSMITTAL

(new nonprovisional applications under 37 CFR 1.53 (b))

Attorney Docket Number: ALLO 4180
First Named Inventor: Jer-Chen Kuo
Express Mail Label Number: EL 493157755 US

TO: Assistant Commissioner for Patents
Box Patent Application
Washington, D.C. 20231

APPLICATION ELEMENTS

1. ☐ Fee Transmittal Form
(original and duplicate)
2. ☒ Specification [Total Pages 11]
3. ☒ Drawings [Total Sheets 04]
4. Oath or Declaration [Total Pages 04]
 - a. ☐ Newly executed (original or copy)
☒ New (unexecuted)
 - b. ☐ Copy from a prior application
(for continuation/divisional with
Box 17 completed)
 - i. ☐ DELETION OF INVENTOR(s)
Signed statement attached
deleting inventor(s) named
in prior application.
5. ☐ Incorporation By Reference
(useable if Box 4b is marked)

The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

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jc639 U.S. PRO

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6. ☐ Microfiche Computer Program (Appendix)
7. ☐ Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
- a. ☐ Computer Readable Copy
- b. ☐ Paper Copy (identical to computer copy)
- c. ☐ Statement verifying identity of above
copies

ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment Papers (cover sheet & document(s))
9. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney
10. ☐ English Translation Document (if applicable)
11. ☐ IDS with PTO-1449 ☐ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard
14. ☐ Small Entity Statement(s)
☐ Statement filed in prior application; status still
proper and desired
15. ☐ Certified Copy of Priority Document(s) if foreign
priority is claimed
16. ☐ Other: _____

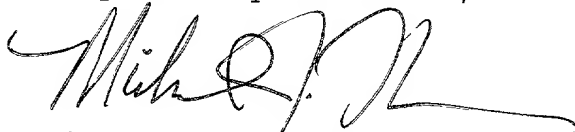
**IF A CONTINUING APPLICATION, CHECK APPROPRIATE
BOXES AND SUPPLY THE REQUISITE INFORMATION**

17. ☐ Continuation ☐ Divisional ☐ Continuation-in-Part
of prior application No.: _____
- ☒ Complete Application based on provisional Application
No. 60/155,892 filed September 27, 1999.

CORRESPONDENCE ADDRESS

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Respectfully submitted,



Michael J. Thomas, Reg. No. 39,857

MJT/cjl

MULTIPLE WAVELENGTH TDMA OPTICAL NETWORKCross Reference to Related Application

This application claims priority to U.S. Provisional Application No.
60/155,892 filed September 27, 1999, the entire disclosure of which is incorporated
herein by reference.

Field of the Invention

This invention relates primarily to passive optical networks and, more
particularly, to passive optical networks utilizing multiple TDMA data streams of
different wavelengths over the same optical transmission line for increased bandwidth
and/or reduced system complexity and cost.

Background of the Invention

Point-to-multipoint passive optical networks are commonly deployed in
telecommunications and cable television local access networks. As shown in Fig. 1A,
a typical passive optical network includes an optical line terminal (OLT), often
located in a Central Office, and multiple optical network units (ONUs) which are
usually located near end-users/subscribers for delivering information (such as voice,
data and/or video) services. One or more passive optical splitters are commonly used
to distribute signals to/from the OLT from/to the ONUs. Because these optical
networks do not require an optical-to-electrical-to-optical conversion at each node,
but rather rely on passive optical components, they are considered more reliable than
active optical networks.

In the downstream direction (i.e., from the OLT to the ONUs), the passive
optical network is a broadcast system; traffic inserted at the OLT is sent to all ONUs.
In the upstream direction (i.e., from the ONUs to the OLT), a time division multiple
access (TDMA) protocol is frequently used to coordinate the sending of multiple
signals to the same OLT point. This is shown generally in Fig. 1B, which illustrates
the TDMA data stream received at the OLT.

In general, increasing the upstream communication bandwidth for a fully-
loaded passive optical network requires an increase in data transmit speeds. However,
higher data speeds typically require more complex and thus expensive electronics for
managing packet alignment and performing packet tracking and synchronization.
Further, higher data speeds usually require higher speed, higher cost optical
transmitters in the ONUs. For these reasons, there are practical limitations on the
extent to which bandwidth can be increased in passive optical networks employing
current TDMA technology.

As an alternative to TDMA protocols, wavelength division multiplexing (WDM) can be used to provide an ONU with increased upstream bandwidth. However, a system employing WDM requires multiple optical transmitters with closely spaced wavelengths, with each ONU being assigned a unique wavelength. WDM is therefore an expensive solution to bandwidth problems because of the high cost of wavelength specific lasers and multi-channel demultiplexing equipment.

Summary of the Invention

In order to solve these and other needs in the art, the inventor hereof has designed an advanced, low-cost, high bandwidth, multiple access technology for passive optical networks. Rather than sharing the bandwidth available over a single wavelength among all ONUs, or assigning each ONU its own unique wavelength, the present invention provides a passive optical network in which multiple wavelengths are used to increase overall system bandwidth, with each wavelength being shared by multiple ONUs according to a TDMA protocol. The upstream TDMA traffic therefore includes multiple TDMA data streams at different wavelengths. The OLT preferably receives the multiple TDMA data streams and separates them to different detectors before ultimately combining all data into a single data stream using a multiplexer after performing clock and data recovery functions. In this manner, the upstream bandwidth in a passive optical network can be markedly increased without requiring an increase in data transmit speeds. It therefore follows that upstream bandwidth in a passive optical network can be increased significantly while using low cost/low speed detectors, and low cost/low speed transceivers in the ONUs, although system bandwidth can be further improved by using higher cost, higher speed components, as apparent.

According to one aspect of the present invention, an optical communication network includes an optical transmission line, an optical line terminal connected to the optical transmission line, a first plurality of optical network units each connected to the optical line terminal and configured for optically transmitting TDMA signals of a first wavelength to the optical line terminal through the optical transmission line, and at least a second plurality of optical network units configured for optically transmitting TDMA signals of a second wavelength different than the first wavelength to the optical line terminal through the optical transmission line.

According to another aspect of the present invention, an optical communication network includes an optical transmission line, an optical line terminal connected to the optical transmission line, and N optical network units. Each optical network unit is connected to and communicates with the optical line terminal through

the optical transmission line at one of M different wavelengths using a TDMA protocol, where N and M are integers and $1 < M < N$.

According to yet another aspect of the present invention, in a passive optical network having an optical line terminal and a first plurality of optical network units passively connected to the optical line terminal through an optical transmission line, the first plurality of optical network units communicating with the optical line terminal at a first wavelength using a TDMA protocol, the improvement comprising a second plurality of optical network units passively connected to the optical line terminal through the same optical transmission line as the first plurality of optical network units, the second plurality of optical network units communicating with the optical line terminal at a second wavelength different than the first wavelength using a TDMA protocol.

According to still another aspect of the present invention, a method of grouping optical transmitters for use in an optical communication network includes the steps of providing a plurality of optical transmitters having the same nominal wavelength, determining the operating wavelength for each of the optical transmitters, and separating the plurality of optical transmitters into a plurality of different groups according to the determined operating wavelengths.

Other features and advantages of the present invention will be in part apparent and in part pointed out hereinafter.

Brief Description of the Drawings

Fig. 1A is a block diagram of a prior art passive optical network using a TDMA protocol for upstream communications.

Fig. 1B illustrates the TDMA data stream that is sent upstream to the optical line terminal (OLT) in the optical network of Fig. 1A.

Fig. 2A is a block diagram of an exemplary passive optical network using two TDMA data streams at different wavelengths according to the present invention.

Figs. 2B and 2C illustrate the two TDMA data streams that are sent upstream through the same optical transmission line in the exemplary optical network of Fig. 2A.

Fig. 3 is a block diagram of the optical line terminal used in the exemplary network of Fig. 2A.

Fig. 4 is a block diagram of an exemplary optical network employing a fault tolerant redundant ring architecture and using two TDMA data streams at different wavelengths according to the present invention.

Figs. 5A and 5B are spectral diagrams for illustrating how several laser diodes having the same nominal wavelength can be separated into two or more different wavelength groups according to the actual operating wavelengths of such diodes.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Detailed Description of Preferred Embodiments

A multiple wavelength TDMA optical network according to one exemplary embodiment of the invention is shown in Fig. 2A and indicated generally by reference character 100. Similar to the prior art optical network shown in Fig. 1A, the exemplary optical network 100 shown in Fig. 2A includes an optical line terminal (OLT) 102 connected to a passive splitter 104 through an optical transmission line 106 (e.g., optical fiber). The optical network 100 also includes several exemplary optical network units (ONUs) 108, 110, 112, 114 each connected to the passive splitter 104 through an associated optical transmission line 118, 120, 122, 124.

Each ONU is configured to send data packets PK1, PK2, ..., or PKN in the upstream direction (i.e., toward the OLT 102) at an appropriate time using a TDMA protocol. These data packets pass through the passive optical splitter 104 and ultimately arrive at the OLT 102 through the optical transmission line 106. In contrast to the prior art, the exemplary ONUs 108-114 do not all communicate with the OLT 102 using the same wavelength. Instead, each ONU is assigned to one of two distinct TDMA groups, with each TDMA group using a wavelength different than that of the other TDMA group. As shown in Fig. 2A, some ONUs 108, 112 communicate with the OLT 102 at a wavelength λ_- , while other ONUs 110, 114 communicate with the OLT 102 at a wavelength λ_+ that is longer than the wavelength λ_- . As a result, two TDMA data streams travel over the same optical transmission line 106 to the OLT 102; one at the wavelength λ_- as illustrated in Fig. 2B, and one at the wavelength λ_+ as illustrated in Fig. 2C. While, in the exemplary network 100 shown in Fig. 2A, only two ONUs are assigned to each TDMA group, those skilled in the art will recognize that this is for illustrative purposes only and that, in many specific implementations of the invention, greater than two ONUs will be assigned to one or more of the TDMA groups.

As further explained below, the OLT 102 receives both TDMA data streams and separates them by wavelength to two different detectors. By using this inventive approach which involves two (or more) TDMA groups operating at different wavelengths, the bandwidth of the exemplary network 100, and thus the bandwidth allocated to each ONU, can be increased without increasing data transmit speeds between the ONUs and the OLT. This is because multiple ONUs can now send data

packets to the OLT 102 at the same time, provided that they transmit data at different wavelengths. Synchronization guard bands may also be made long enough in time to permit detector signal recovery using low cost, low speed electronic circuitry in the OLT 102, as well as low cost, low speed optical transmitters in the ONUs 108-114.

5 In this manner, the present invention provides for a passive optical network having an increased bandwidth while using low cost components. As should be apparent, the invention can also be used to increase the bandwidth of higher cost, higher speed networks.

10 The internal functions of the preferred OLT 102 will now be described with reference to Fig. 3. As shown therein, the OLT 102 preferably includes a wavelength demultiplexer (WDM) 130, which is preferably a passive optical component, a pair of optical receivers (also called optical detectors) 132, 134, a pair of clock/data recovery circuits 136, 138, and a multiplexer 140. The WDM 130 preferably receives the TDMA data streams shown in Figs. 2B and 2C through the optical transmission line 106, and separates these data streams into two separate channels. The TDMA data stream of wavelength λ_- is routed to the optical receiver 132, while the TDMA data stream of wavelength λ_+ is routed to the optical receiver 134, as shown in Fig. 3. Preferably, the wavelengths λ_- and λ_+ are sufficiently separated from one another (e.g., by greater than 30 dB) so that the WDM 130 can provide each of the TDMA data streams to one of the optical receivers 132, 134 without harmful noise. Each independent TDMA data stream is processed by one of the optical receivers 132, 134 and one of the clock/data recovery circuits 136, 138 in a conventional manner. The data streams are then multiplexed together to a common data receiving point 142 using the multiplexer 140. As will be apparent to those skilled in the art, the multiplexer 140 may include buffers for delaying any data packets received out of order by the multiplexer 140.

20 Although only two TDMA groups are utilized in the exemplary optical network 100 described above, it should be apparent that more than two groups can likewise be used. Additional TDMA groups at additional wavelengths are preferably supported by replacing the WDM 130 and the multiplexer 140 shown in Fig. 3 with similar components capable of demultiplexing and multiplexing, respectively, more than two data channels, and by adding an additional optical receiver and an additional clock/data recovery circuit for each additional TDMA wavelength group beyond the two groups described above.

30 It should also be noted that although every other ONU in Fig. 2A is assigned to the same TDMA group, this was done for illustrative purposes only and is not a requirement or limitation of the present invention.

As will be apparent to those skilled in the art, while the exemplary optical network 100 described above employs a tree architecture, the teachings of the present invention are applicable to all point-to-multipoint topologies including ring and bus architectures. An exemplary implementation of the present invention in an optical network having a fault tolerant redundant ring architecture is illustrated in Fig. 4 and indicated generally by reference character 200. As shown in Fig. 4, the network 200 includes an OLT 202 with which several ONUs 204-216 communicate redundantly and bidirectionally through an optical transmission line 220. Similar to the optical network 100 described above with reference to Fig. 2A, each ONU of the optical network 200 is configured to communicate with the OLT 202 using a TDMA protocol at one of two different wavelengths λ_- and λ_+ . Thus, in the optical network 200 of Fig. 4, two (or more) TDMA data streams are preferably used to communicate data from the ONUs 204-216 to a common OLT data entrance point. For purposes of redundancy, the OLT 202 shown in Fig. 4 preferably includes two sets of the components shown in Fig. 3, with each set connected to one end of the optical transmission line 220. Additional details of the optical network 200 and the preferred manner in which the ONUs 204-216 are passively coupled to the optical transmission line 220 are described in U.S. Application No. 09/568,358 filed May 10, 2000, the entire disclosure of which is incorporated herein by reference.

The ONUs included in the exemplary optical networks 100, 200 described above are preferably provided with low cost laser diodes for communicating upstream using a TDMA protocol at one of the wavelengths λ_- and λ_+ . This can be accomplished by providing laser diodes having a nominal (i.e., rated) wavelength of λ_- and laser diodes having a nominal wavelength of λ_+ , as should be apparent. Alternatively, a number of low cost laser diodes having the same nominal wavelength can be tested and separated into two or more distinct wavelength groups according to the present invention. This is because the actual operating wavelength of a laser diode often varies by as much as 20 nm or more from its nominal wavelength. For example, the range of actual operating wavelengths for laser diodes rated at 1310 nm exceeds 1290 nm to 1330 nm.

As shown in Fig. 5A, a laser diode having a nominal wavelength of λ_n may have an operating wavelength anywhere in the spectral window extending from λ_{low} to λ_{high} . Thus, once the actual operating wavelength of the laser diode is determined, that diode can be separated into one of two different wavelength groups λ_- or λ_+ according to whether its actual operating wavelength is greater or less than some reference wavelength, such as the nominal wavelength λ_n as shown in Fig. 5A.

In the case where some degree of isolation is needed between the wavelength groups λ_- and λ_+ , the actual operating wavelength of a particular laser diode can be

compared with two reference wavelengths λ_{r1} and λ_{r2} , as shown in Fig. 5B. Thus, a laser diode having an operating wavelength less than both reference wavelengths λ_{r1} and λ_{r2} can be separated into wavelength group λ_- , and a laser diode having an operating wavelength greater than both reference wavelengths λ_{r1} and λ_{r2} can be separated into wavelength group λ_+ . Laser diodes having operating wavelengths falling between the reference wavelengths λ_{r1} and λ_{r2} are preferably separated into a third wavelength group, and such diodes are preferably not used in combination with the diodes separated into wavelength group λ_- or λ_+ for optical networks requiring a degree of isolation (represented by the difference of the reference wavelengths λ_{r1} and λ_{r2}) between each wavelength group.

As used herein, wavelength λ_+ refers to a wavelength that is longer than wavelength λ_- , and wavelength λ_- refers to a wavelength that is shorter than wavelength λ_+ ; no specific wavelength values are intended. The particular values that should be assigned to wavelengths λ_- and λ_+ in any given implementation of the invention is a matter of design choice. It should also be understood that wavelengths in a relatively narrow spectral range (e.g., wavelengths that would be grouped together by the WDM 130 shown in Fig. 3) are considered the same wavelength for purposes of this disclosure. Thus, wavelength λ_- (also called a "first wavelength") may represent a group of wavelengths in a relatively narrow spectral range that does not overlap with another relatively narrow spectral range of wavelengths that may comprise the wavelength λ_+ (also called a "second wavelength").

When introducing elements of the present invention or the preferred embodiments thereof, the articles "a", "an", "the" and "said" are intended to mean that there are one or more of the elements. The terms "comprising", "including" and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An optical communication network comprising:
an optical transmission line;
an optical line terminal connected to the optical transmission line;
a first plurality of optical network units each connected to the optical line
terminal and configured for optically transmitting TDMA signals of a first wavelength
to the optical line terminal through said optical transmission line; and
at least a second plurality of optical network units each connected to the
optical line terminal and configured for optically transmitting TDMA signals of a
second wavelength different than the first wavelength to the optical line terminal
through said optical transmission line.
2. The optical communication network of claim 1 wherein the optical line
terminal includes a first optical receiver for receiving the TDMA signals of the first
wavelength, and a second optical receiver for receiving the TDMA signals of the
second wavelength.
3. The optical communication network of claim 2 wherein the optical line
terminal includes at least one wavelength division multiplexer connected to the
optical transmission line for routing the TDMA signals of the first wavelength to the
first optical receiver and the TDMA signals of the second wavelength to the second
optical receiver.
4. The optical communication network of claim 2 wherein the optical line
terminal includes first and second recovery circuits connected to the first and second
optical receivers, respectively.
5. The optical communication network of claim 4 wherein the optical line
terminal includes a multiplexer connected to outputs of the first and second recovery
circuits for multiplexing output data to a common data receiving point.
6. The optical communication network of claim 5 wherein the multiplexer
includes buffers for selectively buffering said output data.
7. The optical communication network of claim 1 wherein the optical
transmission line is a fiber optic line.

8. An optical communication network comprising an optical transmission line, an optical line terminal connected to the optical transmission line, and N optical network units, each of the optical network units being connected to and communicating with the optical line terminal through the optical transmission line at one of M different wavelengths using a TDMA protocol, where N and M are integers and $1 < M < N$.

9. The optical communication network of claim 8 wherein M is two.

10. The optical communication network of claim 8 wherein M is greater than two.

11. In a passive optical network having an optical line terminal and a first plurality of optical network units passively connected to the optical line terminal through an optical transmission line, the first plurality of optical network units communicating with the optical line terminal at a first wavelength using a TDMA protocol, the improvement comprising a second plurality of optical network units passively connected to the optical line terminal through the same optical transmission line as the first plurality of optical network units, the second plurality of optical network units communicating with the optical line terminal at a second wavelength different than the first wavelength using a TDMA protocol.

12. The passive optical network of claim 11 wherein the network has an architecture selected from the group consisting of ring, tree and bus architectures.

13. A method of grouping optical transmitters for use in an optical communication network, the method comprising the steps of:

providing a plurality of optical transmitters having the same nominal wavelength;

determining the operating wavelength for each of said optical transmitters; and separating the plurality of optical transmitters into a plurality of different groups according to the determined operating wavelengths.

14. The method of claim 13 wherein the separating step includes identifying at least one reference wavelength and assigning each of the optical transmitters to one of the different groups according to whether its operating wavelength is greater or less than said reference wavelength.

15. The method of claim 14 wherein the separating step includes identifying at least two reference wavelengths and assigning each of the optical transmitters to one of at least three different groups according to whether its operating wavelength is greater or less than each of said two reference wavelengths.

16. The method of claim 15 wherein said three groups include a first group for optical transmitters having operating wavelengths less than both of the two reference wavelengths, a second group for optical transmitters having operating wavelengths greater than both of the two reference wavelengths, and a third group for optical transmitters having operating wavelengths between the two reference wavelengths, the method further comprising the step of using optical transmitters from the first group and the second group, but not the third group, to configure a plurality of optical network units for optically transmitting signals in one of a first wavelength range and a second wavelength range, respectively, in a particular optical network.

17. The method of claim 13 further comprising the step of using one of the groups of optical transmitters to configure a first plurality of optical network units for optically transmitting signals in a first wavelength range, and using another of the groups of optical transmitters to configure a second plurality of optical network units for optically transmitting signals in second wavelength range.

18. The method of claim 17 wherein said signals are TDMA signals.

19. The method of claim 13 wherein the optical transmitters are laser diodes.

20. The method of claim 13 wherein the providing step includes providing a plurality of commercially available optical transmitters having the same nominal wavelength.

MULTIPLE WAVELENGTH TDMA OPTICAL NETWORKAbstract of the Disclosure

A passive optical network which employs multiple wavelengths to increase overall system bandwidth, with each wavelength being shared by multiple optical network units (ONUs) according to a time division multiple access (TDMA) protocol. The upstream TDMA traffic therefore includes multiple TDMA data streams at different wavelengths. An optical line terminal (OLT) preferably receives the multiple TDMA data streams and separates them to different detectors before ultimately combining all data into a single data stream using a multiplexer after performing clock and data recovery functions. In this manner, the upstream bandwidth in a passive optical network can be markedly increased without requiring an increase in data transmit speeds, and while using low cost/low speed detectors in the OLT, and low cost/low speed transceivers in the ONUs. System bandwidth can be further improved by using higher cost, higher speed components.

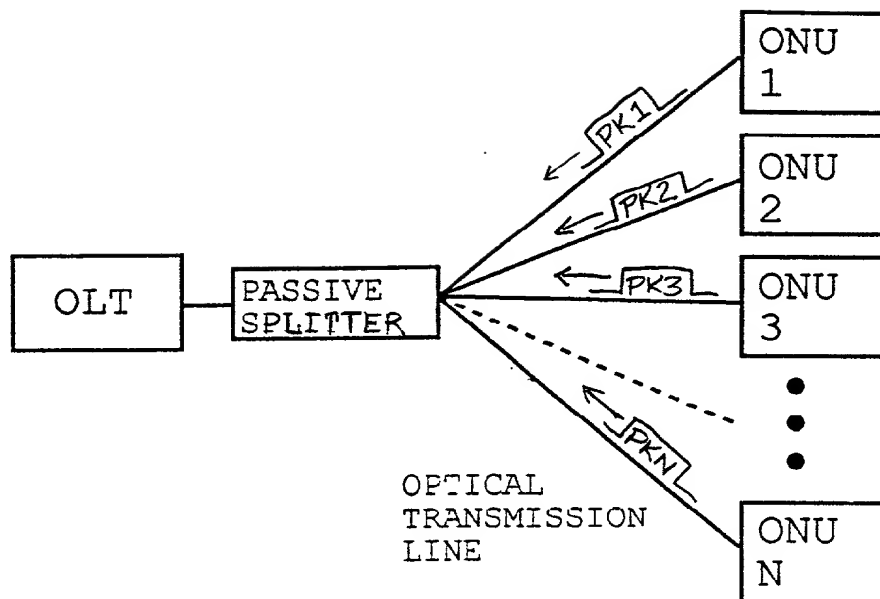


FIG. 1A
(PRIOR ART)

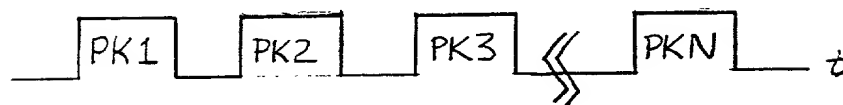


FIG. 1B
(PRIOR ART)

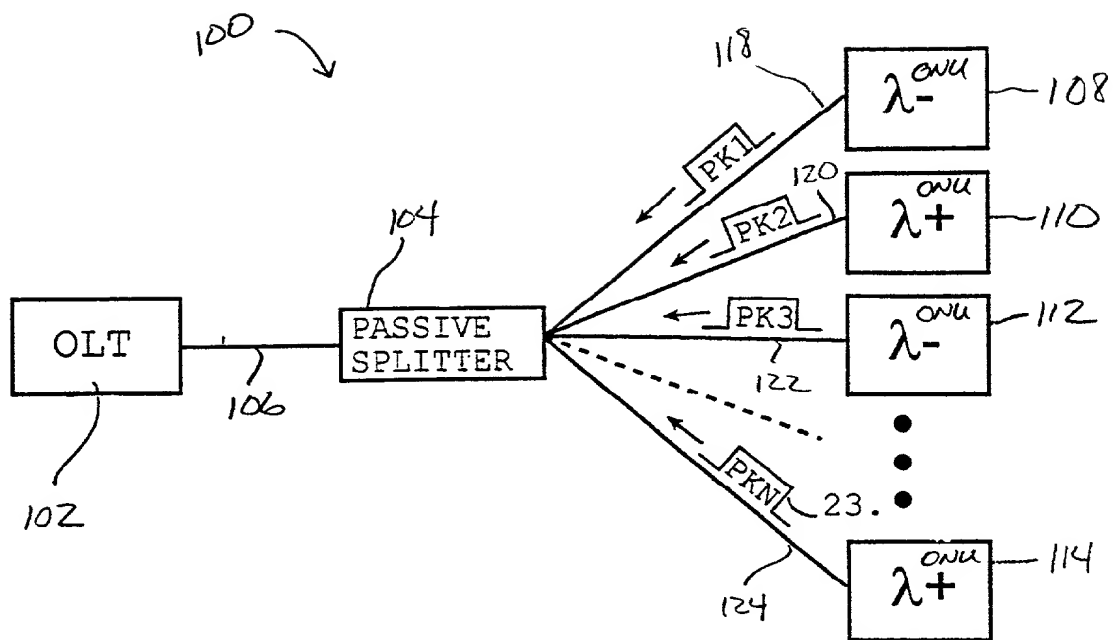


FIG. 2A

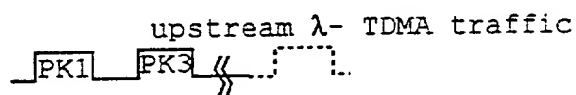


FIG. 2B

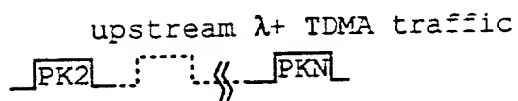


FIG. 2C

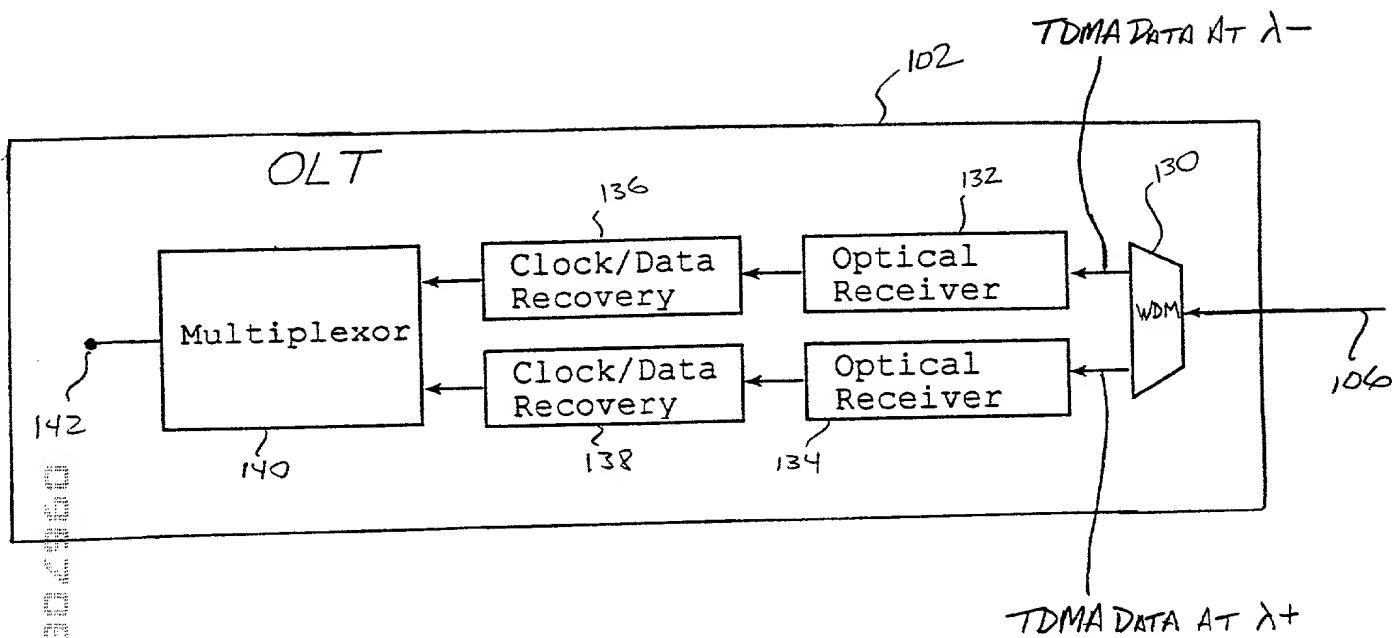


FIG. 3

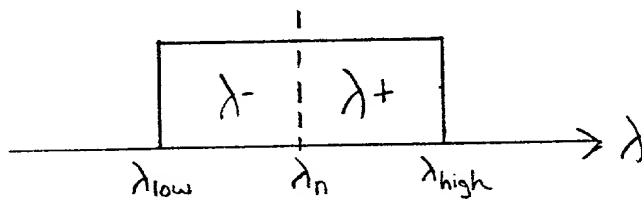


FIG. 5A

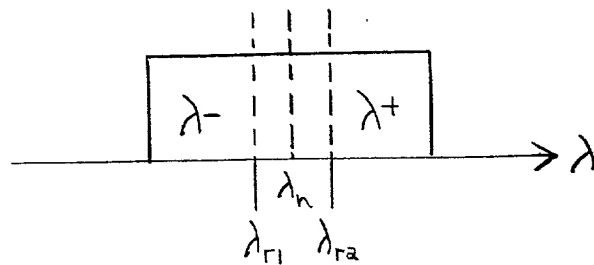


FIG. 5B

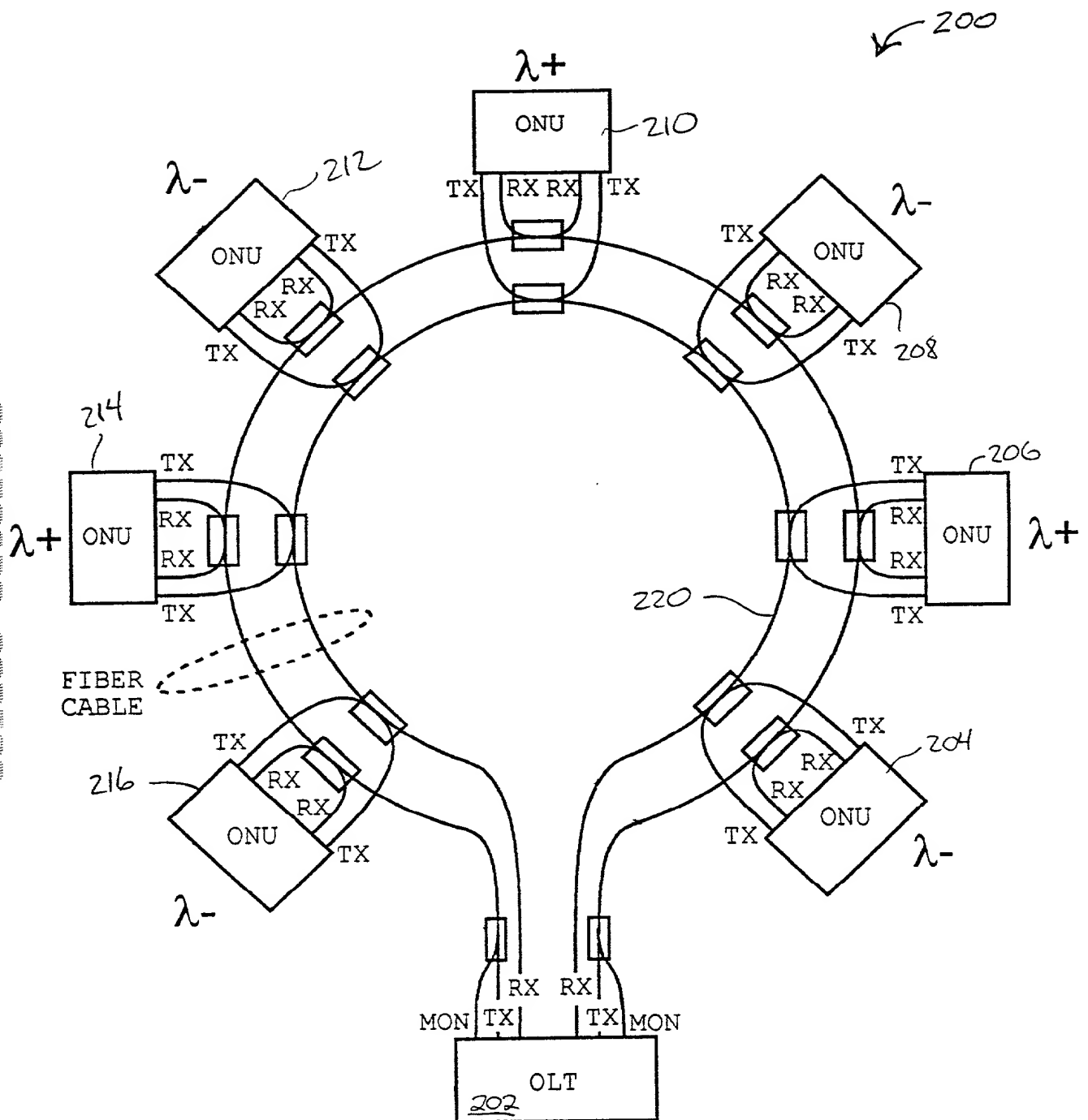
[illegible]

FIG. 4

DECLARATION AND POWER OF ATTORNEY

REGULAR OR DESIGN APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

MULTIPLE WAVELENGTH TDMA OPTICAL NETWORK

the specification of which:

(check one)

☒ [X] is attached hereto

☐ [] was filed on _____ as Application Serial No. _____, and was amended on _____.

☐ [] was described and claimed in PCT International Application No. _____, filed on _____ and as amended under PCT Article 19 on _____, if any.

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations §1.56.

PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a) - (d) or §365(b) of any foreign application for patent or inventor's certificate, or §365(a) of any PCT application which designates at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Priority Claimed

_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)

Priority Not Claimed

ANY FOREIGN APPLICATION(S), ON THE SAME SUBJECT MATTER WHICH HAS A FILING DATE EARLIER THAN THE EARLIEST APPLICATION FROM WHICH PRIORITY IS CLAIMED

_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)
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CLAIM FOR BENEFIT OF PROVISIONAL APPLICATION(S)

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below.

<u>60/155,892</u> (Application Number)	<u>09/27/99</u> (Filing Date)
_____ (Application Number)	_____ (Filing Date)
_____ (Application Number)	_____ (Filing Date)
_____ (Application Number)	_____ (Filing Date)
_____ (Application Number)	_____ (Filing Date)

**CLAIM FOR BENEFIT OF EARLIER U.S. APPLICATION(S)
UNDER 35 U.S.C. 120**

(complete this part only if this is a divisional,
continuation or CIP application)

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s), or §365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

<u>(Serial No.)</u>	<u>(Filing Date)</u>	<u>(Status)</u>
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<u>(Serial No.)</u>	<u>(Filing Date)</u>	<u>(Status)</u>
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POWER OF ATTORNEY

I hereby appoint the following attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: Irving Powers (15,700), Donald G. Leavitt (17,626), John K. Roedel, Jr. (25,914), Michael E. Godar (28,416), Edward J. Hejlek (31,525), William E. Lahey (26,757), Richard G. Heywood (18,224), Frank R. Agovino (27,416), Kurt F. James (33,716), G. Harley Blosser (33,650), Paul I. J. Fleischut (35,513), Vincent M. Keil (36,838), Robert M. Evans, Jr. (36,794), Robert M. Bain (36,736), Joseph A. Schaper (30,493), Kathleen M. Petrillo (35,076), David E. Crawford, Jr. (38,118), Paul A. Maddock (37,877), Scott A. Williams (39,876), Richard L. Bridge (40,529), David M. Gryte (41,809), Christopher M. Goff (41,785), James E. Butler (40,931), Derick E. Allen (43,468), Matthew L. Cutler (43,574), Michael G. Munsell (43,820), Robert J. Lewis (27,210), Karen Y. Hui (44,785), Anthony R. Kinney (44,834), Brian P. Klein (44,837), Sarah J. Chickos (46,157), Donald W. Tuegel (45,424), Steven M. Ritchey (46,321), Michael J. Thomas (39,857), and Kathryn J. Doty (40,593), all of the law firm of SENNIGER, POWERS, LEAVITT & ROEDEL, One Metropolitan Square, 16th Floor, St. Louis, Missouri 63102.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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